

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claims 1-10 (Canceled).

Claim 11 (Currently amended): A method of manufacturing a trench isolation layer, the method comprising:

- (a) sequentially forming a pad oxide layer and a hard mask layer on a semiconductor substrate;
- (b) patterning the hard mask layer and the pad oxide layer by photolithography to form a hard mask pattern and a pad oxide pattern, and forming a spacer along sidewalls of the hard mask pattern and the pad oxide pattern;
- (c) etching a portion of the semiconductor substrate using the hard mask pattern and the spacer as a mask to thereby form a shallow trench;
- (d) forming a thermal oxide layer along inner walls of the semiconductor substrate that define opposed side walls and a bottom wall of the shallow trench, such that the thermal oxide layer has a central portion disposed along the inner wall of the substrate that defines the bottom of the shallow trench, and lateral portions disposed along the inner walls of the substrate that define the opposed side walls of the shallow

trench, respectively, the lateral portions each having a curvilinear sectional profile at an interface with the upper surface of the semiconductor substrate;

(e) while the same spacer used to form the shallow trench is exposed, etching the resulting structure using the hard mask pattern and said spacer as a mask to extend said shallow trench deeper into the semiconductor substrate and thereby form a deep trench, wherein the central portion of the thermal oxide layer is removed, and the lateral portions of the thermal oxide are left in place;

(f) forming one of a high temperature oxide layer, a middle temperature oxide layer and a plasma-enhanced oxide layer as a buffer layer over the entire upper surface of the structure in which the deep trench has been formed;

(g) filling the deep trench, in which the buffer layer has been formed, with a first oxide layer;

(h) planarizing the resulting structure in which the deep trench has been filled with the first oxide layer; and

(i) removing the hard mask pattern.

Claim 12 (Canceled).

Claim 13 (Original): The method of claim 11, and further comprising the step of forming a liner between the buffer layer and the first oxide layer.

Claim 14 (Previously presented): The method of claim 13, and further comprising the step of forming a second oxide layer between the liner and the first oxide layer.

Claim 15 (Original): The method of claim 11, wherein the semiconductor substrate has a silicon-on-insulator (SOI) structure of respective layers that include a silicon substrate, a buried oxide layer, and a monocrystalline silicon layer disposed one atop the other, and wherein step (c) comprises terminating the etching of the semiconductor substrate at a location within the monocrystalline silicon layer in forming the shallow trench.

Claim 16 (Original): The method of claim 15, wherein step (e) comprises terminating the etching of the semiconductor substrate at an interface between two of the respective layers of the SOI structure in forming the deep trench.

Claim 17 (Previously presented): A method of manufacturing a trench isolation layer, the method comprising:

(a) sequentially forming a pad oxide layer and a hard mask layer on a flat upper surface of a semiconductor substrate;

(b) patterning the hard mask layer and the pad oxide layer using photolithography to form a hard mask pattern and a pad oxide pattern on the flat upper surface of the semiconductor substrate;

(c) forming a thermal oxide layer on a portion of the flat upper surface of the semiconductor substrate between respective portions of the pad oxide pattern, such that the thermal oxide layer has a central portion, and lateral portions each having the sectional profile of a bird's beak at an interface with the upper surface of the semiconductor substrate;

(d) etching the resulting structure using the hard mask pattern as a mask to thereby form a deep trench, wherein the central portion of the thermal oxide layer is removed, and the lateral portions of the thermal oxide are left at the interface with the upper surface of the semiconductor substrate;

(e) forming one of a high temperature oxide layer, a middle temperature oxide layer and a plasma-enhanced oxide layer as a buffer layer over the entire upper surface of the resulting structure in which the deep trench has been formed;

(f) filling the deep trench, in which the buffer layer has been formed, with a first oxide layer;

(g) planarizing the resulting structure in which the deep trench has been filled with the first oxide layer; and

(h) removing the hard mask pattern.

Claim 18 (Previously presented): The method of claim 17, and further comprising the step of forming a spacer along sidewalls of the hard mask pattern and the pad oxide pattern, and wherein step (d) comprises etching the central portion of the thermal

oxide layer and the semiconductor substrate using the hard mask pattern and the spacer as a mask to thereby form the deep trench.

Claim 19 (Original) The method of claim 17, and further comprising the step of forming a liner between the buffer layer and the first oxide layer.

Claim 20 (Original) The method of claim 19, and further comprising the step of forming a second oxide layer between the liner and the first oxide layer.

Claim 21 (Original) The method of claim 17, wherein the semiconductor substrate has a silicon-on-insulator (SOI) structure of respective layers that include a silicon substrate, a buried oxide layer, and a monocrystalline silicon layer disposed one atop the other, and wherein step (d) comprises terminating the etching of the semiconductor substrate at an interface between two of the respective layers of the SOI structure in forming the deep trench.

Claim 22 (Canceled).

Claim 23 (Currently amended): ~~The A method of claim 11, wherein step (e) comprises manufacturing a trench isolation layer, the method comprising:~~

(a) sequentially forming a pad oxide layer and a hard mask layer on a semiconductor substrate;

(b) patterning the hard mask layer and the pad oxide layer by photolithography to form a hard mask pattern and a pad oxide pattern;

(c) etching a portion of the semiconductor substrate using the hard mask pattern as a mask to thereby form a shallow trench;

(d) forming a thermal oxide layer along inner walls of the semiconductor substrate that define opposed side walls and a bottom wall of the shallow trench, such that the thermal oxide layer has a central portion disposed along the inner wall of the substrate that defines the bottom of the shallow trench, and lateral portions disposed along the inner walls of the substrate that define the opposed side walls of the shallow trench, respectively, the lateral portions each having a curvilinear sectional profile at an interface with the upper surface of the semiconductor substrate;

(e) removing the entire portion of the thermal oxide layer that is disposed along the bottom of the shallow trench by etching the resulting structure using the hard mask pattern as a mask to extend said shallow trench deeper into the semiconductor substrate and thereby form ~~such that the etching forms~~ a deep trench that has substantially the same width as the shallow trench, wherein the lateral portions of the thermal oxide are left in place;

(f) forming one of a high temperature oxide layer, a middle temperature oxide layer and a plasma-enhanced oxide layer as a buffer layer over the entire upper surface of the structure in which the deep trench has been formed;

(g) filling the deep trench, in which the buffer layer has been formed, with a first oxide layer;

(h) planarizing the resulting structure in which the deep trench has been filled with the first oxide layer; and

(i) removing the hard mask pattern

Claim 24 (Currently amended): The method of claim ~~[12]~~ 11, wherein step (e) comprises etching the resultant structure using only the hard mask and the spacer as a mask, thereby removing the entire portion of the thermal oxide layer that is disposed along the bottom of the shallow trench, whereby the etching forms a deep trench that has substantially the same width as the shallow trench.

Claim 25 (Canceled).

Claim 26 (Previously presented): The method of claim 17, wherein step (d) comprises removing the entire portion of the thermal oxide layer that extends between the lateral portions having the sectional profile of a bird's beak.

Claim 27 (Previously presented): The method of claim 18, wherein step (d) comprises etching the resultant structure using only the hard mask and the spacer as a mask, thereby removing the entire portion of the thermal oxide layer that extends between the lateral portions having the sectional profile of a bird's beak.

Claim 28 (Canceled).